

APPROPRIATE TECHNOLOGY
FOR
APPROPRIATE DEVELOPMENT IN LATIN AMERICA:
A DISCUSSION

by

FRANCISCO JAVIER PICHON

Bachelor of Architecture
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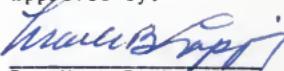
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Approved by:


Dr. Mark B. Lapping
Major Professor

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"In the excitement over the unfolding of his scientific and technical powers, modern man has built a system of production that ravishes nature and a type of society that mutilates man. If only there were more and more wealth, everything else, it is thought, would fall into place. Money is considered to be all-powerful; if it could not actually buy nonmaterial values, such as justice, harmony, beauty, or even health, it could circumvent the need for them or compensate for their loss. The development of production and the acquisition of wealth have thus become the highest goals of the modern world in relation to which all other goals, no matter how much lip-service may still be paid to them, have come to take second place. The highest goals require no justification; all secondary goals have finally to justify themselves in terms of the service their attainment renders to the attainment of the highest. This is the philosophy of materialism, and it is this philosophy - or metaphysics - which is now being challenged by events..."

We shrink back from the truth if we believe that the destructive forces of the modern world can be brought under control simply by mobilizing more resources - of wealth, education, and research - to fight pollution, to preserve wildlife, to discover new sources of energy, and to arrive at more effective agreements on peaceful coexistence. Needless to say, wealth, education, research, and many other things are needed for any civilization, but what is most needed today is a revision of the ends, which these means are meant to serve. And this implies, above all else, the development of a life-style which accords to material things their proper, legitimate place, which is secondary and not primary."

E. F. SCHUMACHER
Small is Beautiful

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Throughout this report extensive use is made of the written work of many authors whose varying opinions on technology transfer issues represented strong bases for analysis. Without access to this extensive body of evidence, this Master's report could not have been completed in its present form.

The most important acknowledgement comes last. I have been aided beyond measure by my parents, Pedro and Beatriz. Their solid example and willingness of sacrifice have always constituted my biggest source of motivation. It is a singular pleasure and honor for me to dedicate this humble work to them.

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INTRODUCTION

Since the start of the decolonization process, most of the Third World nations have been constantly engaged in achieving two interrelated goals: (a) political consolidation and nation building and, (b) modernization of their societies through the diffusion of technology for economic growth (Montavon 1979). Modernization is presently the most important goal before these societies. Along with the political questions related to the institutional structure existing within them, strategies and policies in the area of modernization through technology transfer are, however, being questioned.

The issue of appropriate technology, linked as it is with the views of policy-makers, cannot be divorced from politics. Within this framework, intervention by outside agents through the transfer of technology from rich to poor countries is filled with difficulties, especially in terms of the ethical dilemmas it raises. Some criticisms, reflecting on past experiences, argue that the only favorable solution is to cease intervention altogether. I believe, however that any such indiscriminate rejection is incorrect, just as indiscriminate acceptance of intervention is also irresponsible. The benefit which outsiders can

bring, I hold, should not be completely denied, especially in the face of real needs. To take the question of intervention seriously, then, is to ask under what terms and conditions and under what guidelines should service be rendered.

Technology transfer has become a very emotional issue in many developing countries, particularly in those where governments, while understanding the importance of the subject, do not fully appreciate the complexities of the transfer process.

When the question is debated in international conferences, the industrialized nations and the multinational corporations are often accused of narrow selfishness, of charging exorbitant fees or royalties, of enforcing a multitude of restrictive provisions, and of completely neglecting the interests of the recipients. The multinational corporations admit that excesses may have been committed in isolated cases, but reject blanket condemnation and assert that, overall, the transfer has been a successful one (Martin 1981). Their arguments, however, do not seem to have been very convincing since in a growing number of countries restrictive legislation has or is being enacted, a policy which many consider to be dangerous and self-defeating in the long run.

There is no doubt that countries whose potential in human and natural resources has not yet been translated into

effective production will have to acquire essential technologies corresponding both to their specific ecology and needs. The extent to which they do so will determine whether the crisis affecting the modern world is solved peacefully or not. The developing countries await a correct scientific answer to the difficult questions involved in the development of tropical and equatorial zones. They are convinced that this scientific approach can and must be reflected in effective technologies commensurate with their needs and resources. They know that a wealthy nation's technology, which is itself the result of a long effort starting from initial poverty, is not always capable of responding within the required time to the urgent challenge of poverty.

By force of circumstances these countries must follow an essentially austere economic path in order to ensure that the essential needs of their people are met within a reasonable and politically acceptable period of time. However, too little is known about the basic interactions of technology with development, and too little is known in most instances about the basic characteristics of the developing countries to permit construction of an optimum plan for use of technology development. Within this framework, the present report demonstrates that, in the absence of such information, planning for the integration of technology has tended to become capricious and inconsistent. Furthermore,

this study also discusses some actions that could be pursued by local governments in order to improve the process of adoption and dissemination of appropriate technology in local contexts.

Definitions

Technology may be defined as the systematic application of collective human rationality to the solution of problems by asserting control over nature and over human processes of all kind (Goulet 1977). Technology is generally the result of systematic research which is disciplined and cumulative. Moreover, it is not mere intellectual speculation or theoretical modeling but rather knowledge applied to practical problems. Furthermore, this systematically applied human reason must operate in a social context and result in a tool, process, or object which can be used by others. Technological activity, then, aims at expanding and improving the ability of human beings to control the natural and social forces which surround them.

Because most "modern" technology has originated outside underdeveloped countries, it is essential to define technology transfer. For British economist Charles Cooper technology transfer is "the exchange from advanced to developing countries of the elements of technical know-how which are normally required in setting up and operating new production facilities and which are normally in very short

supply or totally absent in developing economies." This definition is not comprehensive enough, however, because there are also many technologies which do not relate directly to the operation of product-producing or -processing facilities. Thus, the concept of technology transfer must also embrace the circulation of know-how used to conduct feasibility or marketing studies and to manage varied services in terms of transportation, distribution, etc.

The term transfer as used in this report refers to the circulation of know-how across national boundaries; excluded from consideration are transfers of technology from one sector to another within nations. More narrowly viewed, technology transfers are related to the circulation of know-how which is directly applied to the production of goods, the provision of services, and the formulation of decisions (as to site, engineering design, scale, etc.) affecting these.

Purpose and Scope

Technology is a vast domain touching all sectors of human activity. A question arises, therefore, as to which technology transfers are included and which are excluded from the scope of this report. Because some choice bearing on manageability of data had to be made, it is focused on industrial technologies used in production, with only

secondary attention paid to agricultural and communication technologies. Even though the impact of military technology transfers is important today, it is not studied here because proper study of this matter requires special access to data which are unavailable.

This report centers only on transactions between developed countries and Latin America, but even within that continent, comprehensive coverage has not been attempted. Moreover, because broad differences between large and small nations, structurally complex societies and those less so, and those possessing different technical capacities are mirrored in the larger Third World (including Asia, Africa, and the Arab countries), the value of generalizations drawn from this work will be limited. Nevertheless, value conflicts in industry do illustrate larger patterns of technological dependency, tensions between efficiency and social goals, and the crucial importance of overall incentive systems in any society.

An important distinction must also be made between those value conflicts which pit Third World nations against rich-country exporters of technology and those which weigh on poor populations whenever technological decisions are monopolized by a specialized elite, whether foreign or domestic. In this sense, the present report is situated primarily at the level of relations conducted across national boundaries. Nonetheless, tensions between national

decision-makers and nonexpert majorities hover constantly in the background, especially when criteria for technology policy are discussed and incompatibilities surface between technological efficiency and broader goals such as social justice or job-creation. To oscillate from one pole to another is not fully avoidable, inasmuch as strong correlations exist between Third World countries' attempts as nations to improve their relative bargaining position in international technology arenas and their domestic efforts to remove technological power from the hands of few specialists. Clearly there can be no "technology for the people" if control is vested in foreign corporations. On the other hand, shifting control from foreigners to national technicians, politicians, or entrepreneurs cannot, of itself, guarantee a policy which benefits the masses.

One of the major objectives of this report is to examine the vital connection which links the value content of modern technology to basic development strategies and to technology policies adopted in the developing countries of Latin America. In order to accomplish this, Part I of this report explores the background of the transfer process. In Chapter 1, a prior question is asked: What is the relation between technology and development? To answer this question, there have been selected four aspects in the way technology affects development. Technology is considered as:

- 1) A major resource for creating new wealth;
- 2) An instrument allowing its owners to exercise social control in various forms in the way it creates new organization for production;
- 3) A means of affecting modes of decision-making; and
- 4) A means of affecting patterns of alienation characteristic of affluent societies.

The study of technology transfer as a division of the study of economic growth and social change is not well developed as an explicit focus of academic interest. However, all theories of economic development and social change contain within them more or less implicit positions on the role and impact of technology transfer on development. In chapter 2 of this report three groups of theories are identified in terms of the scale of analysis at which these theories operate and whether or not development is defined within them entirely in terms of the benefits of economic growth:

- 1) The first group of theories can be called "Modernization Theories." They focus on national societies as the basic units of analysis and define development in terms of economic growth and "Westernization," replicating the historical experience of Western societies (Tipps 1973; Pletsch 1981).
- 2) The second group consists of theories that focus on

the structure of economic and political relationships between "dominant" and "dominated" societies in the context of the global history of economic growth and political control. These theories are called "World Political Economy Theories" (Evans 1979; Agnew 1982).

- 3) A third group of theories takes an approach that involves a critical perspective on the purported benefits of development as usually defined and emphasizes the ecological and socio/cultural disruption consequent to economic growth (Yapa 1980). Currently this is the last known theory of development and involves the greatest departure from conventional wisdom.

The literature has tended to single out a "bundle" of theories of development, variously described as modernization and neo-classical economic theories, and to label them as "diffusionist." The implication is that these theories emphasize diffusion (and technology transfer) while others do not. Within this framework, the discussion in this section of the present report is centered on exploring the links between theories of development and positions on technology transfer in order to appreciate how the different perspectives on technology transfer fit with the various theories of development.

Technology, far from being an inert deposit of

practical knowledge, is itself a rapidly evolving system operating within larger systems also undergoing dynamic transformation. Chapter 3 explores briefly various sources of technological dynamism. These include the competitive capitalist and socialist structures operative in the developed world, the interaction among basic value choices and preferred development strategies in a given society and its relation with technology; and the "sequence of dependency" which marks relations between rich and poor countries in arenas of international exchange.

Technology is portrayed as a "two-edged sword," simultaneously the bearer and destroyer of values (Goulet 1977). It originates in "developed" societies and circulates rapidly in the world through a variety of transfer channels. Much of the current controversy concerning the means of providing technology to the developing countries centers on the nature and conditions of such provision and on the effects of these conditions on the recipient nations. Chapter 4 of this report discusses the conflicts which arise through transfer of technology at three different levels:

- 1) Competing interests of buyers and sellers of technology;
- 2) Tensions between overall development goals and the impact of imported technology on developing nations;
- 3) General questions as to the possibility of

harnessing technology in any society to such humane ends as a satisfying scale operations, ecological soundness, and the just allocation of resources.

The correct choice of technology to be applied to local situations is critical not only to increase general productivity and wealth, but also to increase well-being and to preserve the quality of life and the environment. Thus, Part II of this report moves beyond those general issues presented in Part I to formulate ethical strategies in one specific arena of development decision-making: technology policy. Part II of this study formulates how cooperation between developed countries and the host country can be improved with regard to the transfer of technology. It is precisely through this cooperation that the developing countries would be able not only to acquire the foreign technology under the best financial, technical, political and social conditions, but also to expand their capacity to absorb technology as part of the process of developing a degree of technological economy in the long term.

It is perhaps significant that the preferred phrase in the literature has been "transfer of technology" rather than, for example, "the advancement of technology in developing countries." The choice of the phrase clearly reflects (a) the view that technology is a concrete possession which can be passed over; and (b) that in their technology the developed countries have an acquisition which

has been denied to the developing countries and which should be facilitated to them. The choice of the phrase "transfer of technology" also reflects another basic sentiment within developing countries; the possession of technology should not be a matter of commercial advantage but, in the name of social justice, should be made generally available to all who need it.

The stress in the future might more suitably be placed, not on the ways in which developed countries should "hand over" technology to developing countries, but on the ways both parties can cooperate to engender the fastest possible growth of technological capacity in the developing countries.

PART I
THE BACKGROUND OF TECHNOLOGY TRANSFER

As the creation and expansion of technologically oriented societies is generally accepted as the best if not the only hope for sustained progress for the poor of the world, the dissatisfaction with the relationships of the technology transfer process with the scientific, technical, and cultural environment in the host country constitutes a serious problem. Part I of this report first deals with the impact of technology on development and the existing links between theories of development and positions on technology transfer. The value content and dynamisms of "modern" technology as well as the institutional framework of the transfer process are also analyzed throughout the first four chapters of this report.

In Part I, particular emphasis is placed on ethical and value questions on the existing mechanisms and channels of technology transfer. Thus, it becomes necessary to raise the issues of freedom and just society. Although development can be studied as an economic, political, educational, or social phenomenon, its ultimate goals are those of existence itself: to provide all men with the opportunity to live full human lives.

CHAPTER 1

TECHNOLOGY AND DEVELOPMENT

Technology is viewed by many of the leaders of the various developing nations as a key to national autonomy and status in the world community. Automotive plants, steel mills, and atomic reactors have also become status symbols of achievement regardless of economic and social costs.

Effectiveness in developing and applying technology depends upon linkages to scientific knowledge and to broader cultural contexts. Linking the understanding of nature to empirical knowledge aimed at controlling the environment took many centuries of gradual development. The technological revolution which followed the scientific revolution brought together "application and cognition, matter and the mind, tool and purpose, knowledge and control" (Donner 1976, 3:36-44). Associated with these linkages were basic changes in social values and attitudes and in economic policies and organization.

Repeated reference has been made to the growing technological gaps between industrially advanced and industrially developing areas of the world. It is important

to distinguish the potential gains to productivity and the industrial growth rate derived from improvements in management, in economic policy, an in technological structure. The latter refers to induced characteristics of plant size and production scale, the accommodation of techniques to factor scarcities, specialization and interdependence among plants contributing to related end products, and the types of managers and innovators associated with production modes. Market development also has been repeatedly cited as the prime mover in technological development (Ward 1968, 7-19). Technological adjustment can only be made within a framework of economic policy and managerial capability.

This study in technology transfer examines competing visions of benefits sought in technological exchanges. Within this framework, the relation between technology and development must first be elucidated.

The Relationship of Technology to Development

Technology affects development in four ways: It is a major resource for creating new wealth; it is an instrument allowing its owners to exercise social control in various forms; it affects modes of decision-making; and it relates directly to patterns of alienation characteristic of affluent societies (Goulet 1977, 7).

Technology as Resource

Those who seek development await such benefits as improved material living standards and new wealth through greater production and productivity. Most development agents assign an important role to technology in reaching these objectives. Indeed, if suitably chosen and properly applied, technology can add greatly to a society's pool of resources. Technology as a resource must obviously be distinguished from other types of resources, particularly "natural" resources which exist in different states of exploitation. Many resources, in turn, are not natural but human creations - capital, machinery, infrastructures. Human skills themselves range from strong muscles for pushing wheelbarrows to elaborate forms of knowledge needed to program computers. Technology is merely one special kind of human skill: the know-how derived from scientific knowledge and incorporated in some object, process, or activity.

For centuries most resources have consisted of tangible goods supplied by nature: fertile land, plentiful game, abundant ores, lush timber, etc. As economic life grew more complex, however, humanly created resources took on greater relative importance. Labor skills, communication networks, symbols which conferred meaning to tasks, and social-incentive systems all became "factors" of production. Moreover, with the advent of capitalist industrialism, still

other "resources" such as entrepreneurial skills, access to diversified markets, and negotiating talents, gained salience. Thus the creation of technology became an economic activity, responsive to pressures of demand and supply. Laboratories were built as factories for producing technology, which came to be perceived as a special capital good with an exceptionally high multiplier effect. Technology is a key resource because those who possess it can be capable of possessing finance capital and other resources as "natural" resources. Conversely, without technology, even an abundance of other factors of production augurs ill for economic success. .

But technology never exists in a social vacuum; it is owned by identifiable interest groups who may use it as an instrument of social control.

Technology as Instrument of Social Control

Multinational corporations have long used their special mastery of technology to gain for themselves not only the economic advantages but cultural and political influence as well.

The exercise of social control by technological elites is greatly facilitated by the arcane language and symbolism they employ. Technological knowledge confers upon these who possess it the power to define problems, to delimit alternative solutions, and to influence outcomes.

Most Latin American nations have pursued modern technology not only for economic reasons but also to reduce their vulnerability to control by technologically advanced nations. Technological mastery is indeed a passport to decision-making power.

Technology and Decision-Making

Some have contended that today's problems are so complex that only specialists know how to define problems and list possible solutions. Others have retorted that this very complexity condemns elitism to failure and makes it necessary for the presumed beneficiaries of technology to express their values and aspirations before choices are made. The question here is whether technology's proper dynamism is compatible with these modal values in decision-making.

Feedback operations are essential. They prevent nonexperts from gaining access to essential parameters of the decision process before these are congealed. Some have rejected this portrayal and insist that initial formulations of problems and alternative solutions are themselves the product of some prior exchange in which a first round of feedback leads to a second round of feed-in, and so on. Whatever one's position is, one conclusion emerges: the technological feasibility of circulating information and counter-information conditions decisional modes.

As decisional procedures come to depend increasingly on technology, the danger arises that decision-making with a strong will to power will gain alarming advantages over peers whose primary allegiance is to justice or compassion. That this danger is neither illusory nor remote is illustrated by recent trends in medical and genetic technology as applied to social engineering (Seeley 1974, 1-13).

Technology and Alienation in Abundance

Technology reduces the totality of human meaning to those of its elements which are amenable to problem-solving. Widespread alienation is an eloquent sign that the meaning of life hitherto supplied by cultural belief systems cannot be replaced by technology. Psychologist Erich Fromm points to the equally dehumanizing effects of both "alienation in affluence" and "alienation in misery" (Fromm 1966, ix). His perception stands valid even in the face of the conventional retort that "it is better to be rich and miserable than poor and miserable." What psychologists have learned of relative deprivation suggests that even if poor individuals harbor no hope for personal improvement, the mere vision of a "better" material life on the horizon gives them grounds for escape in fantasy. This form of relief is not longer available, however, to those whose material fantasies have nowhere else to go.

Hence technology is critical to development for four reasons: (1) technology is a resource and the creator of new resources; (2) it is a powerful instrument of social control even as it offers deliverance from underdevelopment; (3) it bears on the quality of decision-making to achieve social change; and (4) it constitutes a central arena wherein new meanings must be created to counter alienation, the antithesis of meaningful living.

CHAPTER 2

TECHNOLOGY TRANSFER AND THEORIES OF DEVELOPMENT

The study of technology transfer as a division of the study of economic growth and social change is not well developed as an explicit focus of academic interest. However, all theories of economic development and social change contain within them more or less implicit positions on the role and impact of technology transfer on development.

This chapter is concerned with exploring the links between theories of development and positions on technology transfer. The set of development theories reviewed is derived from an extensive though not exhaustive reading in the literature. The positions on technology transfer are based on a typology of diffusion perspectives that serves as an organizing principle in the book by Brown (1981).

Theories of Development

A theory of development typically involves defining the concept "development" and providing a rationale for spatial-temporal differences in its extent. In most

theories, "levels" of development equate with levels of economic growth. The definition of Havens and Flinn (1975, 23:469-481) is fairly typical though more specific than most:

Development...involves three interrelated societal activities: (1) the establishment of increased wealth and income as a perceived, attainable goal for the broader masses of a society; (2) the creation and/or selection of adequate means to attain this goal; and (3) the restructuring of society so that there is persistent economic growth

Over the past twenty years "development studies" has come to constitute an increasingly large and vocal interdisciplinary field in social science. Within this field and associated areas of study, such as political development and cultural change, a range of theories has developed, drawing inspiration from a variety of intellectual traditions.

Three groups of theories can be identified in terms of the scale of analysis at which the theories operate and whether or not development is defined entirely in terms of the benefits of economic growth. The first group of theories can be called "Modernization Theories." They focus on national societies as the basic units of analysis and define development in terms of economic growth and "Westernization," replicating the historical experience of Western societies (Tipps 1973, 15:199-226; Pletsch 1981, 23:565-590). The second group consists of theories that focus on the structure of economic and political

relationships between "dominant" and "dominated" societies in the context of the global history of economic growth and political control. These theories are called "World Political Economy Theories" (Evans 1979, 49:15-20; Agnew 1982, 1:159-166). A third group of theories takes an approach which involves a critical perspective on the purported benefits of development as usually defined and emphasizes the ecological and socio/cultural disruption consequent to economic growth (Yapa 1980, vol. 2). Currently, this is the latest group of theories of development and involves the greatest departure from conventional wisdom.

Each of these groups of theories or "schools" is actually and potentially divided by differences of emphasis, specificity and academic disciplines. Table 2.1 contains a list of the theories. In some cases the identified "theory" covers a set of similar if not identical theories. This is the case, for example, with dual economy, modernity, and institutional reform theories.

Table 2.1

Theories of Development

Modernization	Stages of Growth Dual Economy Modernity Institutional Reform "Classic" Marxist
World Political Economy	Leninist Development of Underdevelopment World-System Multinational Corporation
Ecopolitical Economy	Cultural Ecology of Development Meaning of Development

Modernization Theories

The best known stages-of-growth theory is that of Rostow (1956, 1960). Rostow divided European economic history into five stages of growth that can be used as a framework for national development whatever the particular context. Agriculture is a leading sector in the transition from "traditional" to "modern society." Technology plays an important role in development by transforming traditional agriculture into a base for industrial growth. Commercialization of agriculture and the shift away from subsistence production are particularly important in the process of development.

The dual economy approach emerged out of an attempt to understand the coexistence of a traditional sector and a modern sector within those societies previously subjected to Western colonialism. The major emphasis is upon the lack of

interaction between the two sectors. The degree of interaction, however, also figures as a major concern. This is particularly the case in Lewis' "classic" version of the dual economy theory (Lewis 1954, 22:139-191). Productivity increases in agriculture are seen as the mechanism which permits a movement of labor from the agricultural (traditional) to the industrial (modern) sector. Technological change in agriculture and/or dampening of rates of population growth are viewed as central to this process (Ranis and Fei 1961, 43:533-565).

Modernity and institutional reform theories are largely the province of sociologists and political scientists who focus on ideological and institutional components of development. Implicitly, however, ideas about increasing individualism and acceptance of Western ideas are also important to growth stage and dual economy theories. Development is seen as dependent upon the spread of an "achievement orientation," the stimulation of "entrepreneurial activity" and the institutionalization of efficiency and productivity as defining elements of rationality (Cochran 1966, 4:25-38; Montagno 1978, 6:561-568). The literature adopting this perspective is very considerable and has a common assumption, the importance of Western values to development.

The final modernization theory is usually not characterized as such perhaps because of the "company" it is

then forced to keep. But "classic" Marxist writings on development, drawing on Marx's extensive writing on European economic history and more limited writing on other regions, focuses on the process of capital accumulation and economic development within national boundaries. In this theory, stress is applied to the institution of private property, the transition from feudalism to capitalism, the growth of different classes under capitalism, and the spread of capitalism from its "heartland" in Europe (Warren 1980). But one dictum lies at the core of this theory: "the country that is more developed industrially only shows, to the less developed, the image of its own future" (Marx 1967, vol. 1). Countries are the basic units and laws and generalizations drawn from the experience of presently affluent nations can serve as a model for the present and the future of those nations that are still poor.

World Political Economy Theories

There are four major world political economy theories. Each of these claims some sort of relationship to Marx or the "Marxist tradition." The first of these, the Leninist, is a source of the other three. It is represented today by much "Trotskyist" literature and that tradition's stress on the impossibility of "socialism in one country," given the global nature of the capitalist economy (Mandel 1968). Lenin's theory of development revolved around the idea,

typically in slogan form, that "imperialism is the highest stage of capitalism." Lenin saw imperialism under capitalism as the extension of capitalism outside of its historic core into the rest of the world. To stimulate capital accumulation "at home," so to speak, capitalists expended their operations into the rest of the world. Capitalism thus became a global rather than a national economic system and large parts of the world became subservient to the interests and power of the "developed" world from which capitalism emanated.

The "development-of-underdevelopment" and "world-system" approaches are in many respects elaborations upon the Leninist approach rather than entirely new formulations (Brenner 1977, 104:25-91). The development-of-underdevelopment thesis draws largely upon Latin America experience to argue that development in the West has depended upon a systematic process of underdevelopment elsewhere (Frank 1969). In the world-system approach this thesis is founded on the proposition that the periphery of a "modern world-system" that originated in the sixteenth century has provided the resources for development of a European-North Atlantic core (Wallerstein 1974). A long-term dominance of this core over an expanding periphery has arisen with the periphery dependent upon the core for markets, investment, innovation and ideology.

The final world political economy theory is one that

focuses on the role of the multinational corporations as a source of political and economic control. From this perspective, exemplified in the writing of Barnet and Muller (1974), global patterns of development have come increasingly to depend upon the activities of large multinational corporations which view the world as one economic unit.

Ecopolitical Economy Theories

The third type of theory, ecopolitical economy, is based upon an attempt to understand the process of development as economic growth yet place this in the context that is sensitive to the costs as well as benefits of economic growth and cultural change. The origins of this perspective can be seen in the writings of anthropologists on the cultural ecology of development (Geertz 1963), and in a variety of findings of field research on the impact of programs of agricultural innovation. The meaning of development is central to this theory; in contrast to other theories where it is taken for granted (Wallman 1977). Typically, the insights of the world political economy theories are joined with this critical perspective on the value of economic growth.

Technology Transfer and Theories of Development

How does technology transfer fit with the various

theories of development? As Table 2.2 indicates the theories differ greatly in terms of perspective on technology transfer. It should be noted that for some of the development theories the specific perspective on technology transfer, following from the assumptions and emphases of the theory, is implicit rather than explicit. Brown (1981, 10-11) discovered and juxtaposed rather than invented the various perspectives.

Two general points are worth noting. First, the modernization theories tend to have a more positive view of technology transfer than do the other theories. This, of course, is the point noted, if not articulated clearly, by the critics of "diffusionism." Creating mechanisms for the supply of technology, developing infrastructure and/or improving the spread of knowledge about technology are thought to help development. Second, none of the theories of development contains reference to the economic history perspective on technology transfer. Yet it is the economic history perspective that has generated the most empirical research on technology transfer and pinpointed the specific barriers to the easy transfer of technology from one setting to another (Rosenberg 1970, 11:550-575; Hayami 1974, 34:131-148).

Table 2.2

Technology Transfer and Theories of Development

Theory of Development	Perspectives on Technology Transfer
Stages of Growth	Market and Infrastructure
Dual Economy	Market and Infrastructure
Modernity	Adoption
Institutional Reform	Adoption
"Classic" Marxist	Market and Infrastructure
Leninist	Development
Development of Underdevelopment	Development
World-System	Development
Multinational Corporation	Development
Ecopolitical Economy	Development

One important difference within the group of modernization theories is the difference between the modernity/institutional reform theories and the others. There has been a tendency to cluster modernization theories together in discussions of innovation diffusion but it is apparent that when regarded this way there are substantial differences between them. Specifically, the modernity and institutional reform theories focus on value change and Westernization as instruments of development. Thus, technology transfer will depend on receptiveness to innovation. This corresponds most closely to the adoption perspective on technology transfer.

The other modernization theories, however, even though they rest on assumptions concerning value orientations, are directed much more to the benefits that flow from the supply of technology and infrastructure. Technologies can be

imposed despite the initial attitude of the "natives." Economic and political barriers, not social or cultural ones, stand in the way of national development. Coercion or "marketing," in the promotional and advertising sense of the term, is the major mechanism for transformation.

The other theories incorporate a more negative appraisal of technology transfer. Indeed, without exception they subscribe to the "development" perspective on technology transfer. Technology transfer is seen as beneficial to suppliers rather than adopters. It is also seen as "dependency creating." The technology in question is often controlled from elsewhere, may have negative effects in areas where it is introduced and may profit only those who sponsored its introduction (Weinstein and Pillai 1979). Technology transfer also disrupts established and perhaps satisfactory social and ecological patterns.

All types of theories of development, therefore, contain positions on technology transfer. But it appears that these positions are partial and incomplete. For example, modernization theories have no place for evaluating the consequences of technology transfer. World political economy theories also have deficiencies. In particular, they are usually silent on why patterns of control over technologies and other resources must necessarily lead to negative effects upon those to whom technologies are transferred. Technology transfer is assumed to be negative

in its effects without examining the specific situations in which this might or might not be so.

The examination of technology transfer and, more generally, innovation diffusion by students of "development" has been restricted by the limited perspectives on technology transfer contained within the various theories of development they use. Some ways in which the conceptualization of technology transfer can be improved within all theories of development have been suggested (Stewart 1977).

A first requirement is a clear articulation of the relationship between development and technological change. An obvious strength of the world political economy theories is the critical political interpretation of technology transfer that they offer. Technology is viewed not just as technique but as contained within a web of constraining political relationships. Ecopolitical economy theory goes beyond this point to note, as well, the general ecological and cultural consequences of technological change. This theory opens to question whether "bigger is better" and whether capital-intensive is always superior to labor-intensive agriculture. These are the hidden assumptions of modernization theories.

A second requirement is an examination of the political and economic conditions under which technology transfer has in the past led to economic growth. This is where the

economic history perspective comes into play. Economic historians interested in technology transfer try to identify the critical conditions under which technology transfer can be successful. They focus on both local demands and circumstances rather than engage in global generalizations. Rosenberg (1972, 10:3-33), a leading advocate of this viewpoint, summarizes as follows: "the productivity of any technology is never independent of its institutional context and therefore needs to be studied in that context." Unfortunately, theories of development have rarely incorporated this insight.

A third requirement involves the relative centrality of technology within theories of development. Many theories have regarded technology as secondary or even exogenous to the process of development. Improving the treatment of technology by incorporating notions of technical choice and appropriate technology is a necessary pre-requisite for improving the position of technology transfer in theories of development.

A fourth requirement concerns the ideology of the "technical imperative" and how it lays the groundwork for accepting a "marketing" message and, ultimately, acquiring a new technology.

A fifth requirement concerns the interaction between the growth of a Western-style mass education system and the type and rate of technology transfer. This relates to the

previous point on the ideology of "developmentalism" but it is a more specific aspect of it. Easterlin (1981, 41:1-19) has argued that the "personal" element in technology transfer - demonstration, training, personal contact- presupposes a common intellectual and knowledge base and a common educational process. This presupposes the unimportance of economic and political barriers to growth other than the educational system, largely ignores the question of who benefits from growth and fails to address the question of whether growth is always synonymous with development.

In sum, there are several specific respects in which all theories of development are deficient with regard to their conceptualizing of technology transfer. Some theories seem to be better able to incorporate all these aspects of technology transfer than others. Even though open to a variety of criticisms, the world political economy theories and the ecopolitical economy theory provide a good base through their focus on the global setting of technology transfer and their historical orientation toward understanding development.

CHAPTER 3

THE DYNAMICS OF TECHNOLOGY TRANSFER

All human societies display an "existence rationality" (Walshok 1971, 13:451-472). Whatever may be their information-processing capacities and effective access to resources, all human groups devise concrete strategies which enable them to survive, to protect their identity and dignity, and to assert whatever freedoms they can muster over nature, over enemies, and over destructive social forces at work within their own boundaries. These strategies, taken as wholes, constitute their "existence rationality."

The global diffusion of modern technology has tended to standardize the "existence rationality" of all societies around specifically Western notions of efficiency and productivity, rationality, and problem-solving. Thus in societies which are modernizing, not only factories but also the technological approach to life itself gradually come to be viewed as normal. Yet both factories and technology remain alien to experiential landscapes in non-modern settings.

Technological innovators do not intend, of course, to destroy pre-existing values; their overt aim is merely to solve problem more efficiently, to produce goods or provide services according to different standards of quantity and quality than previously. Nevertheless, simply by acting as innovators, they cannot avoid tampering with prior values. Moreover, they shatter the fragile web which binds all the values of pre-modern communities into a meaningful whole.

The Technological Imperative

An inner force drives technology to render actual everything which is possible: this is the redoubtable "technological imperative" (Ellul 1965). The problem is general: means tend to ursup the place of ends: processes express their own dynamisms apart from goals they are meant to serve. Providing that any idea can be translated into an artifact constitutes for technologists a challenge they find irresistible. Momentum builds up within research institutions for them to do something mainly to prove that it is possible. And much irresponsible technological tinkering is encouraged by the benevolent attitude toward change which prevails in "developed" societies, whose general bias favors the view that what is "new" is necessarily better. Technological researchers embrace this bias - and are rewarded by society for their efforts. This bias gives them a vested interest in perpetuating the

"technological imperative," that is, the tendency of technology to impose itself independently of larger purposes.

Technology is itself a rapidly evolving system operating within larger systems also undergoing dynamic transformation. Some development writings imply that science and technology are the common patrimony of mankind and that the "Third World" enjoys advantages in being a latecomer on the scene of technological modernization. The Third World, we have been told, can take technological shortcuts. Yet technology is not a free good, but an economic one, sold dearly to those who can pay for it, not to those who may need it most (Ritchie-Calder 1973, 11).

Technology may be the most vital of economic goods because it can generate new wealth faster than other productive assets - capital, labor, natural resources, etc. Unless exchanges are subsidized, technology must be paid for by buyer. The proper arena for its circulation is some local, regional, national, transnational, or global market. Although much of it is proprietary knowledge, technology tends to circulate faster and easier than most other capital goods, indeed, than many consumer goods themselves. This greater mobility is explained by the relatively intangible nature even of technologies which are incorporated in a "package" of goods or services. What is worth nothing here is that technology circulates, if at all, within arenas of

economic competition in the production and provision of goods, products, and services. Thus is technology caught up in the dynamics of competition.

Competition

Competition is fueled by incentive structures which reward those who are the first at meeting effective purchasing power and its equivalents. Goods are produced and supplied by various enterprises - private, public, or mixed. Their supply role is meaningless, however, unless matched by a vigorously exercised parallel demand function. Whether producers are decisively stimulated by the lure of monies held by purchasers or by the rewards that come from those who wield effective power to set targets, competition remains the basic ground rule of economic activity.

Within capitalism, competition as response to effective buying power enjoys priority as the motor force of mobilization for production. Under socialism, on the other hand, competition responds to motivations based on political, ideological, and bureaucratic interests. Even state-owned enterprises must compete among themselves to be awarded contracts, to gain access to sources of material inputs indispensable to production, and to meet targeted quotas in time to avoid punitive measures. Under both systems, it is competition in the arena of production which dictates the behavior of individual production units, even

though these units respond to diverse stimulus which play the role of inducing and rewarding production in a competitive mode. In other words, in uncontrolled classical free markets, the "competitive edge" is essential to the survival and prosperity of enterprises. In controlled markets (monopoly situations), although the competitive edge is relatively less crucial on purely economic grounds, external considerations dictate some degree of competitiveness. What results is a universalized drive to "keep oneself competitive" by keeping abreast of technological innovations.

Sequence of Dependency and Capital Investment

Technology is correctly viewed as a universe because it is a system of its own whose field of influence is the entire globe. Transnational corporations, within this framework, understand that a competitive edge which has been lost or diluted in "mature" markets can be regained in less mature ones. The history of transnational corporations investment attests to the profitability of technologies and derived products in Third World sites long after the competitive edge, or even basic marketability, has been lost in original industrial sites.

Transnational corporations marketing practices suggest an interesting gloss on the basic theses of Latin America dependency theorists (Bonilla 1973). This added dimension

is called the "sequence of dependency." The sequence is initiated when the dependency of purchasers is expressed in their need for a varying spectrum of goods provided by outside sellers. Initially, public and private firms in less-developed countries depend on outside suppliers for capital. This need leads them to offer inducements to direct investment and other forms of supplying capital, such as loans or grants. After pressing capital needs have been met, however, or at least mitigated, the most pressing demand felt in underdeveloped economies is to import technology. Once again, varied incentives are held out to those who can satisfy this demand.

Managerial Expertise

Many firms whose capital or technology is no longer sought or welcomed are courted for their managerial expertise. In one sense, managerial expertise is simply a particular intangible kind of decisional technology, special in that it can be gained only after long years of experience (Rosenberg and Hageboeck 1973). Thus a firm lacking managerial expertise can acquire it only by an ongoing transfer process which must be contractually negotiated.

Access to Markets

The final component, after capital, technology, and managerial expertise, have been obtained by less-developed

purchasers, is access to markets. Prerequisites of access are an existing network of contacts, specialized legal and bureaucratic skills, and rapid information-processing abilities without which final products would not move fast enough or far enough to amortize the high production-input costs of capital, technology, and managerial expertise. Again is illustrated how tightly technology is bound to the dynamics of competition.

Values, Development Strategies, and Technology Policy

Technology is both a system of its own and a component of larger social systems. Within this framework, it becomes important to analyze its workings alternatively probing technology's inner dynamics and its links to broader social processes. It is particularly useful to see the link which binds society's basic value options to its preferred development strategies and to its technology policy.

Specialists usually discuss development strategies in terms of relative priorities: investment in industry over agriculture, in human resources over infrastructure, tax incentives to foreign firms over increased credit to native firms, and so on. Even though planners rarely consider explicitly the nexus between values and strategic priorities, its existence is undeniable. Therefore if one adheres to the value of greater egalitarianism, one will tend to favor improvements in agriculture over industry,

small technology over mass-scale techniques, subsidies to local firms over "tax holidays" to transnational corporations, and popular decision-making over exclusive reliance on experts. The same interdependence between strategy and values exists at the level of ideology. If one chooses capitalism, with its implied effort to integrate into the world market, values such as self-reliance and local innovation are relegated to the background. If, conversely, one adopts a socialist strategy of development, one will prefer gains in economic independence to pure efficiency and one will attach greater weight to social justice through land reform, for example, than increased output. In other words, value choices and development strategies are intimately linked. And when technology policy is introduced into this equation, the nexus tightens still more.

Many national-technology policy-makers appear not to notice this link; yet no technology policy can succeed if it is not expressly designed to reinforce the social values pursued, in some scale of priorities, by the development strategy adopted. To illustrate, if Tanzania's commitment to self-reliant development, which builds on the communal values of its largely rural communities, is a serious objective, one would expect its technology policy to assign a wide role to "soft" technologies aimed at increasing productivity through optimal use of local resources. Or, as

one reflects on Algeria's declared goal of achieving the full range of industrial capacity for internal and export markets, different technological measures recommend themselves. Among these are: importing foreign technologies to build up competitive capabilities, training nationals in order to limit dependency to the briefest possible period, and achieving a coordinated bargaining posture so as to avoid outside exploitation.

The question in this chapter has been whether qualitative improvement can somehow replace quantitative growth as the driving force of the evolutionary dynamism of technology. This mutability of technology thus has been placed in the context of economic competition, a major stimulus to social change, and within the so-called "sequence of dependency," which less-developed nations might envisage breaking by progressively reducing their reliance on outsiders for capital at a first stage, then technology, later managerial expertise, and finally, access to markets. A further dimension of this technological dynamism constitutes its vital connection to broad value choices constantly being made within changing societies and to preferred development strategies.

CHAPTER 4

THE INSTITUTIONAL ASPECTS OF TECHNOLOGY TRANSFER

Strong social aspirations and political sentiments are attached to the subject of the transfer of technology, as is evident from the type of technology claimed, and as has been repeatedly emphasized by the spokesmen of the developing countries themselves.

The purpose of this chapter is to describe methods of transfer of technology in use, their advantages and the political objections which have been raised to them. To entirely disregard these political issues in the present study would be an omission. Within this context, also discussed are some social and political implications of the transfer of technology to developing countries.

The reader may keep in mind that this report is an attempt to judge in what ways the technological aspirations of the developing countries of Latin America can be satisfied and how specific methods can be adopted for this purpose in the future. It must be borne in mind that the intensive documentation already accorded to this subject in no way diminishes the need for rational thinking in the

future. The advance of technological and therefore economic capacity in developing countries is essential to the relief of hardship and social distress in those countries. It is also vital to the future growth of the developed world.

Existing Methods of Transfer of Technology

The Private Sector

International direct investment, i.e. the transfer of productive capital from one country to another, has been a major vehicle for the transfer of technology (Frost 1978, 2). The mechanisms for the transfer of these various knowledge components include direct investment by foreign companies; licensing agreements, where a developing country firm obtains machinery and technology from a foreign firm; management-consultancy agreements, where the developing country requires managerial skills; technical-assistance agreements; industrial cooperation, and so on. In the case of direct investment, the technology package comes more or less complete. The other arrangements involve taking the package apart, and attempting to "de-package" or "re-package" according to particular needs (U.S. Department of State 1979).

Direct Investment

The essential function of international direct investment is to transfer capital between countries for the

purpose of creating new commercial or industrial facilities in the recipient country. These facilities may be purely for the purpose of marketing, and may consist simply of the provision of storage sites, offices and selling points; for the pursuit of service activities, such as communications, transport and financial or professional vocations; but they are most generally for the pursuit of manufacturing, mining and plantations. The motive for international direct investment appears to be primarily to provide, through local rather than distant home production, fuller coverage of local markets; second, to take advantage of local labor and material supplies; and third, in the case of mining and plantations activities, to supply capital in the only areas where the natural resources occur (U.S. Agency for International Development 1977).

International investment has, for decades, played an important role in the world economic development, except in Europe, where capital accumulation necessarily had to be self-generating and slow. Many Latin American countries including Argentina, Brazil and Venezuela, have received substantial capital contributions from economies that had developed earlier. The general effect has been to permit capital to accumulate in those countries at faster rates than would otherwise have been possible.

The International Company

The international transfer of capital for industrial and commercial processes is necessarily the work of companies within the private producing sector of the economy. Such companies have been active throughout modern economic history.

International direct investment installs, in the host country, new plants, factories, warehouses, offices and marketing organizations. In the case of manufacture, the investing company will broadly duplicate in the host country the output already established in the host country. In the case of mines and plantations, the investing companies will duplicate techniques perfected in other areas where similar deposits exist, or where similar plant life can be sustained. Where the natural resources are unique to the area concerned, the investing company will attempt to devise optimum techniques of output (Seneviratne 1979).

The new enterprise set up in the host country will, if successful, develop in size and complexity and in self-generated financial resources. This will call for the implantation of supervisory, administrative, executive, financial, accounting, legal and ancillary expertise. As the new enterprise begins to develop its chosen market, it will find itself obliged fairly quickly to set in place the necessary commercial organization. It will require a sales force under a sales manager or sales director; it will

require storage facilities, supervised by staff conversant with stock intake, storage, control, audit, and dispatch problems; it will require specialists in the sphere of transport and communications. The new enterprise will need, in addition, market research, alone with analysts, linguists, economists and consultants.

Transfer of Technology

The central decision to create a commercial and industrial entity in a host country implies the application of the scientific, technical, industrial, administrative, financial and marketing knowledge, without which the new enterprise cannot function. These various forms of knowledge constitute the "package" normally subsumed under the term "transfer of technology." The acquisition of this knowledge would, in the ordinary course of events, be costly for the area concerned, involving considerable expenditure on general and advanced educational facilities, on specialist scientific and technical training, on engineering and process-operation instruction, and on training in commercial, financial, accounting and other business procedures. However, the nature of international direct investment is such that the cost of acquiring such knowledge is self-financing. This is to say that the knowledge concerned is transmitted as a result of the provision by the parent company of the appropriate machinery, operating instructions, qualified staff and management cadres. The

cost of these, in the form of royalties, fees and salaries constitute operating costs against the trading revenues of the new enterprise. The total operating costs of the enterprise - which will also include wages, materials and standing charges - will, in the early stages of its life, normally exceed trading revenues. The resultant deficits will be met by capital inputs from the parent (these are, in the early life of a subsidiary, usually large). If the enterprise progresses satisfactorily, however, its trading revenues will begin to match its operating costs and so cover the cost of technological acquisitions; more generally, if the enterprise is successful then revenues will exceed costs and a stream of profits will ensue. This will generate a positive cash flow, with the result that the subsidiary will itself begin to generate internal sources of funds, and will itself become a wealth-producing entity (Seneviratne 1979).

It has been noted above that the successful new enterprise will generate internal resources in increasing measure, which themselves constitute new production of wealth. The effect of this on the general educational and technological level of the host country can be gauged if the universe of international company subsidiaries established in a particular country can be visualized. These enterprises, taken as a whole, will form a substantial source of new GDP (Gross Domestic Product); that is to say,

they will raise the level of overall demand, and will raise the general standard of living of the country in question. This will stimulate both new forms of enterprise, new requirements for technological qualifications, and new resources for financing the acquisition of these qualifications.

The Public Sector

Besides the flows of private direct investment from the developed world to developing nations, a roughly equivalent amount is channelled through a variety of official aid programs, including one dealing specifically with technical assistance.

Technical Content of Official Aid

The bulk of official aid expenditure is on people, and on informational and research institutions. To the extent that the transfer of technology takes place through people, this disbursement enables foreign nationals to pass on knowledge while working in developing countries.

Apart from technical knowledge transferred by means of official grants to support people, an informal transfer of technology is effected through grants, surveys, etc., financed by other official aid. For instance, a grant to help devise and build a hydroelectric scheme necessarily involves the import of machinery into the host country; this

will require operating and servicing by local technicians. At the same time, engineers and other technically qualified people who work alongside local personnel will inevitably impart their knowledge. So this type of unrecorded transfer must be added to transfers which take place through normal trade and investment channels (The Development Coordination Committee 1978).

Official aid enables technical knowledge to be transferred to host countries essentially through the transfer of qualified personnel to work with local people. How effectively this knowledge is absorbed and used is difficult to measure. This subject will be explored when some of the problems encountered with the existing methods of transferring technology be considered.

Problems Encountered with the Methods of
Transfer of Technology

International private investment has encountered opposition in many Latin American countries during recent years. Disaffection with what were categorized as "the restrictive business practice" of some international companies led to active government intervention in individual countries. In a number of countries strict codes have been introduced to define the economic sectors in which international investment could take place, and attaching to this investment detailed conditions on such matters as

levels of employment, imports and exports, capital expenditure, local financing, profit remittances, royalty and management fee payments, local equity participation and transfers of capital from and to the parent company. Recently, many developing countries embarked on a policy of progressive nationalization of foreign enterprises; the terms under which the value of these enterprises was reimbursed were often held to be unsatisfactory by the original owners. In addition, a number of countries adopted policies of progressively appropriating existing foreign enterprises and excluding new entrants. Other countries, among them Nigeria and Iran, sought to bring about early transfer of effective ownership through compulsory allotment of equity participation to local residents. These various policies and regulations were pursued in varying degrees over the years, and frequently with large and unforeseen changes of aims and requirement (Germidis 1977).

Objections to International Investment

The objections to international investment raised by Latin American countries may be broadly characterized as political, in the sense that they refer to the national interest of the particular country, as conceived by the government of the day.

Financing:

Developing-country governments are keenly aware that

the central financial operation of international companies lies in a flow of capital from the parent company to the subsidiary and a return of flow of dividends and interest from the subsidiary to the parent. Given that in any company, whether international or other, the input of external capital cannot, over a protracted period, exceed or indeed equal the profit arising, if the enterprise is to be financially viable. In the case of any individual international company the outflows of dividends and interest will in the medium to longer term exceed the inflow of capital from the parent. Only a proportion of dividends and interest due to the parent will in fact be remitted, the remainder being withheld inside the subsidiary for its future use. The flows visible to the developing country, however, will be those actually across the exchanges.

Moreover, the books of the subsidiary will show the retained profits as capital accretions in the name of the parent. In the universe of multinational corporations operating in any given developing country there will be, assuming expansion of activity in that locality, a continuing stream of new capital for new enterprises, which will offset the capital/profit imbalance referred above. However, where foreign investment is in fact declining, this will not occur. A decline in new investment streams has been the case in many developing countries (Stopford and Wells 1972).

An allied consideration is the possibility, at least in principle, of the covert transfer of profits in other guises, notably in the form of enlarged royalty and management fee payments, and through the medium of transfer pricing; this last entails the overcharging of materials supplied to the subsidiary by the parent and the underpricing of products sent from the subsidiary to the parent, the effect being a transfer of income from the subsidiary to the parent.

National Jurisdiction:

A broader class of objections resides in the proposition that multinational corporations are able to escape the jurisdiction of the host-country government. In an immediate way, this will clearly arise from the transfer-pricing referred to above, in that the multinational corporations, in as much as they do not have the long-term interest of the developing country at heart, are able and willing to transfer their production facilities elsewhere if greater advantages present themselves in other countries.

Cost of Technology:

In a domain more specific to the question of the transfer of technology, developing countries' governments have objected to the established system of industrial property rights, including particularly patent licenses and royalty payments. It has been felt that the economies of

the various developing countries, which have been unable to develop technology of this sort for themselves, have been unjustly burdened with the cost of using industrialized countries' technology and that this knowledge should be freely shared. In the same line of thinking, developing countries have taken some exception to the practice of parent companies charging royalties and fees to subsidiaries for the use of patents owned by the parent, in order to defray its development costs.

Balance of Payments:

Other objections by developing countries have related to the balance of payments. It has been felt that multinational corporations burden the external account of countries not only in inducing a stream of profits in excess of incoming capital, but in generating new categories of imports, in the form of material for use in production; in not exporting at a desirable level, owing perhaps to regional marketing arrangements; and in moving short-term funds in order to profit from changes in the value of currency.

The Political and Social Context

It is perhaps significant that the preferred phrase has been "transfer of Technology" rather than, for example, "the advancement of technology in developing countries." The choice of the term clearly reflects: (a) the view that the

technology is a concrete possession which can be passed on; and (b) that in their technology the developed countries have an acquisition which has been denied to the developing countries and which should be restored to them.

The sense of past deprivation and the wish to emulate are accompaniments of the political awakening of nations that have gained political independence comparatively recently, in the case of the African continent. However, it would be unfortunate if such a sentiment were allowed to color current attitudes. The stress for the future might more suitably be placed, not on ways in which developed countries should "hand over" technology to developing countries, but on ways in which both parties can cooperate to engender the fastest possible growth of technological capacity within developing countries.

Private Enterprise and State Ethics

The choice of the phrase "transfer of technology" reflects a further basic sentiment within developing countries. This is, that the possession of technology should not be a matter of commercial advantage but that, in the name of social justice, it should be made generally available to all who need it.

This reflection stems from a view of economic society more akin to state-socialist principles perhaps, than to the private-enterprise concepts that prevail in the Western

democracies and Japan. In these countries it is widely believed that social justice cannot be achieved through the state ownership of property and that, while all individuals are equal at law and in opportunity, they must necessarily be unequal in attainment. Their governments, accordingly, foster private enterprise, profits and competitive markets.

It is useless to call upon these governments, and still less private enterprise, to provide free access to patents and technological expertise, and to repudiate the laws of property upon which their industrial democracy is founded.

In another respect, attitudes occasionally manifested in developing countries, whether or not correct in themselves, may handicap them in the search for technological advancement. A distaste for the circumstances of industrialization, and a preference for the contemplative, or indeed the quietest, life, is implicit in the society of some developing countries. A community must be free to choose either way of life; the choice has been made, with greater or lesser difficulty, in countries now industrialized.

However, a country cannot at the same time seek technological and therefore industrial progress, while preferring the virtues of a non-industrialized community. It cannot, for example, encourage 95 per cent of its university students to study sociology, the arts, and philosophy, and only 5 per cent to study science. Countries

seeking material progress must clearly create a social and intellectual context within which industry can flourish.

A clear evidence of the above attitudes is represented by the private business sector in many Latin American countries. This sector has often been discouraged because of governments' distaste for the entrepreneurial spirit. These attitudes are difficult to reconcile with a desire for technological advancement. It is difficult to seek the aid and sympathy of countries wedded to the entrepreneurial motive, while discouraging this motive at home.

The Politicization of the Problem of Technology

It has already been observed that the demand for industrial and technical equality with the developed nations originated, at least in part, in the immediate post-colonial climate of political opinion prevalent in developing countries. There is evidence that the issue has remained highly political.

Industrial and technological equality has become a major part of the foreign policy of developing countries and of their representative organizations. Affirmation or rejection of the industrial and technological theses of developing countries has become in many ways a test not of technical wisdom, but of political prestige.

Similarly, within the confines of many developing countries the intellect and vigor of young students has been

drawn, not to the research and analysis of scientific and technical problems, but to theories of economic growth in emulation of developed countries, and to the construction of studies illustrating the moral liability of developed countries, or the entitlement of developing countries.

These diplomatic and academic activities have merit and are not wasted; however, there is a danger that they will be overshadow the need for more concrete thinking and effort. The danger is that the focus of action will be transferred to these areas, from the milieu in which it should be centred: that of industry and production.

In the final analysis, the developing countries will not achieve self-development and attain real independence in a perspective of international scientific collaboration unless they are themselves active agents of their own transformation through their own knowledge and with the active support of the developed regions of the world. The real battle for development, therefore, is fought by the nationals of developing countries under their own constraints with their own resources.

PART II

THE NEED FOR TECHNOLOGY PLANNING

After exploring the background of technology and the ways in which technology circulates from rich to poor societies, this report now inquires into some questions of technology policy for development.

Technology policy embraces a vast network of domains relating to a nation's scientific and technical pool, material and financial infrastructure, overall incentive system, attitude toward outside agents, degree of control over the direction and speed of planned social change, level of integration into global or regional economies, and relative priorities attaching to technological modernity itself.

Many Latin American countries now recognize that these burdens imposed by the transfer process abound because they lack a well-articulated technology policy which links development objectives to the dynamics of technological innovation and to prevailing patterns of transfer.

Technological policy-makers in Latin America must reflect critically on the principles underlying development strategies, that is, on the basic value options of their respective societies.

CHAPTER 5

TECHNOLOGY TRANSFER AND PUBLIC POLICY

Technology is "a powerful means of international policy: it serves as a new means of projecting national influence and power into the international arena" (Hetman 1973, 31). The 1972 Organization of American States meeting of Latin American governments in Brasilia (OAS 1972, 10-11) declared that

science and technology offer infinite possibilities for providing the people with the well-being that they seek. But in Latin American countries the potentialities that this wealth of the modern world offers have by no means been realized to the degree and extent necessary.

This chapter explores policies consonants with the aspiration of many Latin American countries to acquire greater technological maturity, viability, and autonomy.

Basic Options in Development

All efforts at diagnosis and prescription center on value judgments about what constitutes a good, or a better, human society is. For some a better society is one in which greater access to opportunity, if not to more tangible benefits, is created; for others the goal is effective equality in modes of greater or lesser participation; for

still others the basic aim is to assure the planetary survival in modes which salvage human liberties. The three images are not mutually exclusive, nor are they always found in their pure state.

More crucial than the ideology it espouses, however, is whether a society conceives of development merely as the pursuit of certain benefits or as the quest of these benefits in a certain mode. How benefits are obtained is as essential to defining development as the fact that they are obtained. This is not to underestimate the importance of benefits sought - greater material welfare, higher production and productivity, more efficient institutions, the growing ability to sustain dynamic economic performance. Yet it matters enormously how these gains are obtained: in a pattern of high, or of low, dependency on outside powers; in a equitable distributional mode or in ways which enhance the privileges of favored minorities to the detriment of needier masses; in a paternalistic, impositional style or in ways which progressively empower the people to choose its targets and the instruments to reach them. All these values refer to the mode of change, not primarily to its targeted content.

The relevant point in this section of the study is that varying images point to diverse policies indicating how developmental benefits will be sought. Table 5.1 shows some of the central questions affecting the desired mode of

development.

Table 5.1

Central Questions Affecting the Mode of Development (Ferkiss 1974).

- Which institutional arrangements best promote development goals (politically centralized or decentralized, degree of coercion in planning, etc.)?
- What relative roles are to be assigned to political leaders, experts, technicians, and "the people?" This decision affects the degree of elitism or technocracy of the development effort.
- Which social classes or interest groups will be made to bear the costs of change, and how will relative burdens be assigned?
- Which time spans are to be deemed tolerable before targeted gains are effectively reached?
- What degree of coercion from above will be judged acceptable?
- What measure of self-reliance or dependence on the outside is permitted or encouraged?
- Is priority given to material or to moral incentives? Or a mixture of both?

The answers to these questions form a systematic whole which constitutes, in effect, a society's development strategy. Even though decisions taken on all points are important, it is particularly essential to focus on a few of them. These are now discussed below.

The Contact with the Outside World

No Third World nation can successfully pursue a fully independent course. Nevertheless, important differences of degree are discernible among nations; some are more highly integrated with outside systems than others. At times, links are one-sided, as in the case of Cuba and its ties with the Soviet Union and Eastern European socialist nations. Algeria, on the contrary, provides an example of wide diversification in its linkages with other countries and regions. In Brazil, the primary integration seen is with the international market, not with a single nation or region. Preferences as to kind, degree, and locus of integration constitute a strategic development option fraught with consequences for technology policy. Indeed one major thesis presented by Latin American dependency theorists (Bonilla 1973) states that domestic constraints on successful development are mainly due to structures of dependency imposed by outside forces which operate in symbiosis with interest groups representing the social forces of "internal colonialism" (Gonzalez-Casanova 1969, 118-139). Whether one accepts or rejects these views, they correctly note how decisive for development strategies are decisions about degrees of integration with outside systems. It is no accident, therefore, that the "Brazilian model" of development imposed by the military government since 1964 has profoundly affected the kinds of technologies adopted,

the allotment of social costs in the country, and the relative neglect of all but large-scale agriculture sub-sectors (Furtado 1972, 1-127). Once Brazil's planners decided to compete in the world market on the market's own terms, they were automatically giving direction to their strategy on other fronts and foreclosing alternative options.

By striving to achieve competitiveness in world markets, a nation commits itself to certain industrial priorities or to large-scale industrialized agriculture over and against other alternatives, to certain patterns of consumer-goods production favoring the privileged classes, to supplying export needs over meeting internal demands, and to other policies having greater or lesser impact on technological choices. Therefore, whenever a national development plan in some Third World country requires a high degree of integration with the regional export market, a whole amount of supportive infrastructure investments is implied rendered necessary so as to assure competitive efficiency. Choosing integration implies selecting technology which is capital-intensive and of standardized international quality. It also means plant scales opposed to the requirements of small and medium industry as well as an agricultural sector to the detriment of the poorest and least productive. Implied also are an employment policy which provides training and subsidies

to small numbers of skilled and professional personnel, and monetary and fiscal policies ill-suited to produce equitable redistribution inasmuch as subsidies favor efficient export sectors. For these reasons developmental efforts aimed at integration to big powers or to the world market set limits to strategies which can effectively be adopted.

The Strategies of Autonomy and Self-Reliance

Tanzania holds pride of place among nations advocating self-reliance as a development strategy. One constant principle in the thought of President Julius Nyerere is that "there is no model for us to copy" (Nyerere 1968, 19-20). He writes that

in 1965 Tanzania adopted its own form of democracy - we rejected the Western model and said it was not appropriate for our circumstances despite the fact that all our constitutional development had until then been based on it...

When we introduced this new system, we were criticized for abandoning democracy... In response to this criticism we tried to explain what we were trying to do and why we thought our new system was both democratic and suitable for our conditions. But having done that we did not worry about what the Western countries said or what democratic theorists said. For in rejecting the idea that we had to follow the Westminster model if we wanted to be democratic, we had also overcome the psychological need to have a certificate of approval from the West in relation to our political system.

What Nyerere claims for a political system - freedom from servility to previously existing models - he likewise urges upon his nation in its approach to economic problems:

We have deliberately decided to grow, as a society, out of our own roots, but in a particular direction and

towards a particular kind of objective. We are doing this by emphasizing certain characteristics of our traditional organization, and extending them so that they can embrace the possibilities of modern technology and enables us to meet the challenge of life in the twentieth century world (Nyerere 1968, 2).

The economy must be organized so as to free people from manipulation by the market; "the first priority of production must be the manufacture and distribution of such goods as will allow every member of society to have sufficient food, clothing and shelter, to sustain a decent life (Nyerere 1968, 11). This is the heart of self-reliance: the commitment to creative innovation and adaptation in the light of local constraints, values, priorities, and heritage. Any nation pursuing a self-reliant strategy of development must institutionalize its critique of prevailing as much as possible outside models. It must also adopt criteria for choosing technologies and modes of their utilization drawn from outside the technological market place. In this analysis, foreign technologies are not excluded on principle, but imported will be only those types of technology which foster locally defined goals.

China serves as an exceptional example of a nation adopting a developmental strategy which emphasizes self-reliance not only at the national level but also within regional, local, and productive-unit levels. The Lagos Plan of Action (LPA) in Africa, on the other hand, offers

an excellent model. This plan emerged at a time of discouraging economic trends: 20 years of stagnation in outputs; deteriorating terms of trade; increased payments for the import of high level skills, capital goods, and spare parts; and increased unemployment and poverty (OAU, ECA, ADB 1982:3). It assumes that the past and current policies were not adequate to successfully address the present economic problems. Thus the LPA was designed to restructure the economy of Africa, based on the twin principles of national and collective self-reliant and self-sustaining development (OAU, ECA, ADB 1982:3). As a corrective measure, the LPA proposed that individual governments involve youth in agricultural development in order to arrest the rural-urban drift, create effective incentives in the agricultural sector, and establish joint efforts to deal with such regional agricultural problems as pest control and seed selection. Nevertheless, even self-reliance cannot be an absolute principle, and it must not be interpreted to mean excluding outside influences. Moreover, even where national planners do not choose self-reliance as their primary policy, it is possible within limited sectors such as agriculture or housing to champion a self-reliant approach which will have important implications on choices and modes of technology. Similarly, if planners take as a basic strategy a serious attack on mass poverty and unemployment, a strong orientation will

exist in favor of lesser integration with international markets and greater local inventiveness to correct factor distortions inherent in imported technologies. In every case there are limits beyond which neither efficiency nor equity can be ignored. Yet on balance, a basic option on the scale of degrees of integration and self-reliance is the central point within which technology policies can be evaluated. Because reality imposes compromises, no country's plan is fully consistent with its basic options, and unexpected events can suddenly make self-reliant nations more "integrated" with the outside than formerly was the case. Nonetheless, any nation's decision-makers will ultimately have to place primarily importance either to integration or to self-reliance. The degree to which they will blend the two will depend on the so-called incentive systems at work in their societies.

Incentive Systems

The market is a vigorous mechanism for motivating people to produce, sell, buy, and consume. It assumes the existence of a shared incentive system around which buyers and sellers see comparative and mutual advantages in playing their roles. The existence of effective purchasing power in the hands of a pool of prospective buyers is the incentive leading producers and consumers alike to engage in the processes of generating supply and demand. The market

undoubtedly needs various subordinate mechanisms to work such as price, competition, and demand stimulation (Wallich 1973, 62). It must not be supposed, however, that societies organized around other basic incentive systems can dispense with markets. On the contrary, even socialist societies rely on markets. But instead of serving as the organizing principle of economic life, the market in these societies acts as a regulatory mechanism to control against waste, duplication, and overcentralization. The market is subordinated to a plan relying on persuasion, some consensus about priority needs, or a mobilization around collective moral incentives (Mannheim 1951, 191). Within this context competition is not eliminated but takes on secondary importance: It is not the dynamic motor of effort; it merely stimulates and channels effort, usually under the rubric of "socialist emulation" and in support of targets set by some plan (Mannheim 1951, 193).

A very striking testimony in the subject comes from Carl A. Gerstacker, chairman of the Dow Chemical Company (Barnet and Muller 1974, 55): "It is in reality the profit motive that makes industry responsive to social needs. Therefore, once it becomes profitable to be just, managers moved by material incentives will respond." Clearly governments may act as intermediaries between profit-makers and needy consumers lacking buying power. Yet even equitable social-welfare policies must overcome the dominant

influence exercised on sectoral policy by the basic incentive systems. Not surprisingly, powerless needy groups are neglected while potentially dangerous ones are appeased. The perdurability, within industrial countries, not only of "pockets of poverty" but also of several social groups "left out" of the benefits of development suggests that governmental correctives to the profit incentive factor cannot abolish mass misery.

No development strategy can avoid making a basic choice: either to develop for the benefit of those who are already privileged or to embrace a pattern of development aimed at abolishing misery for all citizens and to create an incentive system capable of institutionalizing this priority.

National-development planners who initially opt in favor of achieving industrial capacity, both for a domestic and for foreign markets, cannot avoid a high degree of dependency on outside suppliers of technology. Some countries, such as Brazil, view this dependency as only temporary; they express confidence in their ability to import technology on a large scale and from diversified sources for a limited number of years and, in a second phase, to gain a relative degree of autonomy. Only the time will reveal whether their optimistic expectations are realistic or not. Under favorable circumstances, perhaps a few Third World nations can acquire relative technological

autonomy from outside sources, but in order to do so these nations must enter the competitive arena of technology. In short, gaining technological competitiveness is not synonymous with gaining technological freedom. The freedom in question is that of exploring technologies better adapted to local needs and of creating conditions which allow a society to control, at least relatively, the speed and direction of technical change. However, not every country with a small market can be self-sufficient even in the production of modest consumer goods. Moreover, countries with a dearth of resources will need advanced technology in certain domains; they need a judicious choice of many technologies. Therefore, even a sound austerity policy cannot be applied absolutely. Nor need it exclude the selective importation of modern technology, provided this activity is subordinated to larger goals. The powerful stimulus of competition will not then be abandoned but subordinated to deeper values, equity, control and balance.

Concerted Action

A Latin American partnership is very much needed to gain bargaining power in purchasing foreign technology. Latin American nations need science and technology because the two are "among the crucial tools necessary for increasing national independence and welfare" (Seidel 1974, ix). But neither independence nor welfare can be obtained

by the developing countries if they act alone. Political leaders in Latin America must perceive technological cooperation as useful and indispensable. Cooperation in technology means creating horizontal relationships to replace the vertical ones with current suppliers which now prevail, thanks to the near-monopoly industrialized countries have over technological innovation. As Raul Prebisch urges in his book Change and Development, Latin America's Great Task (Prebisch 1970, 5), the Third World quest for a new international economic order may well remain a dead letter unless cooperative efforts are made to "horizontalize" their technological relationships.

Some writers urge establishing regional or international public institutions for industrial research and development (National Academy of Sciences 1973). However, even within the Andean Pact, where broad agreement exists on economic and industrial policy, it has proven difficult to implement technological cooperation (Seidel 1974, 10-14). Difficulties are traceable in part to uneven technological levels. Brazil may sell technology to Bolivia and Colombia, but it does not thereby gain much useful knowledge for conducting its negotiations with the United States. In addition to mere commercial contracts, institutional cooperation is needed on such issues as information exchange, bargaining strategies, training, regional research, and diverse efforts to change existing

legislation on proprietary knowledge. Also, concerted action must include the provision of advisory services, financing, and the promotion of local values through the development of technologies adapted to these.

Information Exchanges

Latin American countries may find it useful to collaborate in setting up monitoring teams to gather information supportive of the policy of "opening up the package." In this sense, as Jan Tinbergen (1974, 9) suggests, creating a "new autonomous institute for technological exchange to link suppliers (enterprises and universities) with user-countries... In this, universities and user-countries could act as counter-weights against enterprises."

Bargaining Position

Efforts by Latin American representatives must center on adopting common positions on such issues as economic rights, sovereignty over resources, and controlling activities of foreign suppliers of technology. Pressure must also be applied to get approval of codes of conduct governing foreign investment and technology transfer. Such codes must include norms for negotiated technology purchases, training national personnel, rules for technical supervision, and terms of sales to third countries. If a

large number of Latin American countries reach a common position on these issues, it is more likely to have negotiations much more equitable with multinational corporations. Success in codes, however, is conditioned by the level of political commitment governments assume.

Joint Training

Argentina has pioneered an autonomous approach to nuclear-energy production using natural uranium (Sabato 1973, 1:23-28). This example hints at increasing Latin American abilities to provide training in some sectors, which is another way of "horizontalizing" relations. The road to autonomy lies in building a network embracing training policy, professional incentive systems, and criteria for weighing efficiency and lessened dependence.

Cooperation in Research and Development Infrastructure

The usual argument against building research facilities in developing countries is that domestic markets are too small to support them. Large countries like Brazil and Argentina can identify specific sectors in which national research is warranted in scale terms (Ranis 1972, 34). In this sense, Sagasti and Guerrero suggest that Andean sub-regional talents mobilize and create their own transnational corporations, some of which should engage in research and development on behalf of the region (Sagasti

and Guerrero 1974, 98).

Modifying Existing Legislation on Proprietary Knowledge

The basis for considering knowledge to be proprietary is positive law, expressed in the form of international agreements and national legislation on intellectual property. If current rules governing proprietary knowledge are maintained, poor countries can never achieve relative technological parity with the rich. Unless technology becomes "the common patrimony of the human race," inequitable rewards will continue to be gained by those who already enjoy a privileged position in technological arenas. Perhaps, the long-term task consists in creating a noncommercial basis for technology-research on the basis of priority need altering the role of research and development activities as mere adjuncts of profit-seeking enterprises.

Obviously many Latin American governments are shy away from cooperation with others; mutual distrust is perhaps the major political obstacle blocking concerted action. Yet this obstacle is not absolute. In the final analysis, the developing countries will not achieve self-development and attain real independence in a perspective of international scientific collaboration unless they be themselves active agents of their own transformation through their own knowledge and with the active support of the developed

regions of the world. The real battle for development, once again, is fought by the national of developing countries under their own constraints with their own resources.

CONCLUSION

The present report has identified the background of the technology transfer process (Part I) and the need to treat technology explicitly in planning in the spectrum of development strategies available to planners and decision-makers in the Latin American nations (Part II).

Most countries in the world seek to get access to modern technologies, at a fair price, in a mode which allows them to make optimal use of their local resources and in ways which minimize their dependency on outside suppliers. In order to reflect these desires on concrete policies, any society must assess its constraints and the power it has for implementing its wishes. Both constraints and power, however, vary widely.

Large countries such as Brazil, Argentina, or Algeria for instance, may look for a degree of technological "modernity" - even by following the path of high technological imports - while sacrificing on other objectives such as optimization of local resource use. They hope, eventually, to achieve technological efficiency. Many smaller countries such as Colombia, Ecuador, or Paraguay, on the other hand, may find that their chronic need to purchase

foreign technology invalidates their hope of getting relative technological autonomy. Beyond such variables the decisive elements in policy are the basic options and development strategies selected by a society.

What is important here is to relate science and technology policies directly to overall planning objectives and to assure that measures taken to attract or control technology are coherent and supportive of society's broadest goals.

The instruments which have been used by Latin American governments such as mandatory registry of technology contracts, ceiling on payments, requirements to use local technology where available, etc., tend to reduce dependency and minimize costs. But control alone is not enough. National and regional science and technology capacities must be built up. Thus, emphasis must be placed on new forms of training, creating local research and development facilities to promote a range of "appropriate" technologies responsive to local factors and large social objectives.

Throughout any actions incentives are central to purchasers of technology, to intermediate agencies (financial and consulting firms), and to the actual human resource. Individual countries need to discover new combinations with other Third World actors, and support by appropriate international actions. Third World policy-making, however, does not take place in isolation.

The context of technology is an international order dominated by transnational corporations, international agencies, and big power governments. As Indian economist Rajni Kothari writes (Kothari 1974, 9), it is no longer possible to bring successful change in one area, except in very marginal ways, without taking account of the world context. Technology, then, is not static. Rather, it is a dynamic social force which provides its possessors economic, political, and cultural power.

Because it is never possible to make great gains without paying social and human costs, the criteria for deciding which costs will be viewed as tolerable must be defined, preferable after consultation with the intended beneficiaries of policy and, above all, with the people which must bear those costs. Furthermore, as Denis Goulet writes (Goulet 1977, 251),

As all societies struggle to create a world of genuine development, value conflicts will endure. But these conflicts, like technology itself, can prove beneficial. The key lies in the criteria chosen to decide which values will be destroyed and which will be preserved. Technology is indeed a two-edged sword, at once beneficent and destructive. But so is development itself. So is all of human history.

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APPROPRIATE TECHNOLOGY
FOR
APPROPRIATE DEVELOPMENT IN LATIN AMERICA:
A DISCUSSION

by

FRANCISCO JAVIER PICHON

Bachelor of Architecture
University Autonoma del Caribe, Colombia - 1985

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**APPROPRIATE TECHNOLOGY
FOR
APPROPRIATE DEVELOPMENT IN LATIN AMERICA:
A DISCUSSION**

How is technology related to development? Can technology be "transferred" from one cultural setting to another in ways which are more beneficial than destructive? How do policies for becoming technologically "modern" relate to development goals in diverse nations? These questions constitute the heart of the present report.

Technology is a vast domain touching all sectors of human activity; it is also a dynamic force which provides its possessors economic, political, and cultural power.

Voluminous writings on "technology transfer" have now made their way into the literature on development. Because some choice regarding manageability of data has to be made, this report concentrates on industrial technologies used in production, with secondary attention paid to agricultural and communication technologies. The present report centers on transactions between developed countries and Latin America, but even within that continent, comprehensiveness coverage has not been attempted. In addition, the study is situated primarily at the level of relations conducted across national boundaries. Nonetheless, tensions between national decision-makers and nonexpert majorities hover

constantly in the background, especially when criteria for technology policy are discussed and incompatibilities appear between technological efficiency and national goals such as social justice and job-creation.

One major premise of this report is the existence of the vital connection which links the value content of modern technology to development strategies and public policy adopted in less-developed countries.

The background of the technology transfer process is presented in Part I of this report, in which competing views of benefits sought in technological exchanges are examined. Many conflicts have been traceable to technology itself, not merely to the mechanisms by which it is "transferred" from one national setting to another. Within this context, technology is then analyzed in terms of its own values, dynamisms and institutional framework, where basic questions of freedom and just society are raised.

In Part II, this report moves beyond this general background of technology and formulates ethical strategies in the arena of development decision-making. In this section of the report, it is particularly useful to see the link which binds a society's basic value options to its preferred development strategies and to its technology policy. Many national-technology policy-makers in Latin America appear not to notice this link; yet no technology policy can succeed if it is not expressly designed to reinforce the social values pursued, in some scale of

priorities, by the development strategy adopted. Beyond such variables, what is important here is to relate science and technology policies directly to overall planning objectives and to assure that measures taken to control technology are coherent and supportive of a society's broadest goals. But control alone is not enough. National and regional science and technology capacities must be built up. Thus, emphasis must be placed on new forms of training, creating local research and development facilities in order to promote a range of "appropriate" technologies responsive to local factors and social objectives.

Throughout any actions, incentives are central to purchasers and sellers of technology, to intermediate agencies (financial and consulting firms), and to the actual human resources. Thus, individual countries need to discover new combinations with other Third World actors in an environment of partnership and cooperation. Third World policy-making, however, does not take place in isolation. The context of technology is an international order dominated by transnational corporations, international agencies, and big power governments. Yet this obstacle is not absolute. The stress for the future might more suitably be placed, not on the ways in which developed countries should "hand over" technology to developing countries, but on the ways in which both parties can cooperate to engender the growth of technology capacity in developing countries. It is precisely through this cooperation that the developing

countries of Latin America might be able to acquire the foreign technology under the best financial, technical, political, and social conditions, as well as to expand their capacity to absorb technology as part of the process of developing a degree of technological economy in the long term.